Benthic & Bacteria TMDL Development for the Occoquan River Basin

VDEQ-NRO, Virginia

March 1, 2005

THE Louis Berger Group, INC.

Virginia TMDL Experience:

Watershed	Project Description	Status
Occoquan River Watershed, Virginia	The listed segments are Broad Run, Kettle Run, South Run, Bull Run, and Popes Head Creek. The impairments are **bacteria** and **benthic** macroinvertebrates.	In Progress
Roanoke River Basin, Virginia	The listed segments are Wilson Creek, Ore Branch, Beaverdam Creek, Turnip Creek, Cub Creek, Buffalo Creek, and 3 mainstem segments of the Roanoke River. The impairments are **bacteria** and **benthic** macroinvertebrates.	In Progress
Jackson River, Virginia	The Jackson River is impaired for **dissolved oxygen** and **benthic** impairment. The dissolved oxygen impairment is 11.21 miles long, and the benthic impairment listing is 24.21 miles in length.	In Progress
Roanoke River Basin, Virginia	The listed segments are Birch Creek, Falling River, Flat Creek and Twittys Creek. The impairments are **bacteria** and **benthic** macroinvertebrates. The Birch Creek and Falling River bacteria TMDLs were approved on May 26 and July 9, 2004. The Flat Creek and Twittys Creek benthic TMDLs were approved on August 5 and September 30, 2004.	Approved
Nottoway River Basin, Virginia	The listed segment is an unnamed tributary to Hurricane Branch. The impairment is **benthic** macroinvertebrates. The benthic TMDL was approved on September 30, 2004.	Approved
Chowan River Basin, Virginia	The listed segment is Roses Creek. The impairments are **bacteria** and **benthic** macroinvertebrates. The bacteria TMDL was approved on July 6, 2004. The benthic impairment was delisted after completion of the stressor identification.	Approved
New River Basin, Virginia	The listed segments are Dodd Creek and Mill Creek. The impairments are **bacteria**. The Mill Creek TMDL was approved on June 5, 2002. The Dodd Creek TMDL was approved on December 11, 2002.	Approved
Big Tennessee River Basin, Virginia	The listed segment is Little Creek. The impairment is **bacteria**. The TMDL was approved on June 5, 2002.	Approved

Objective:

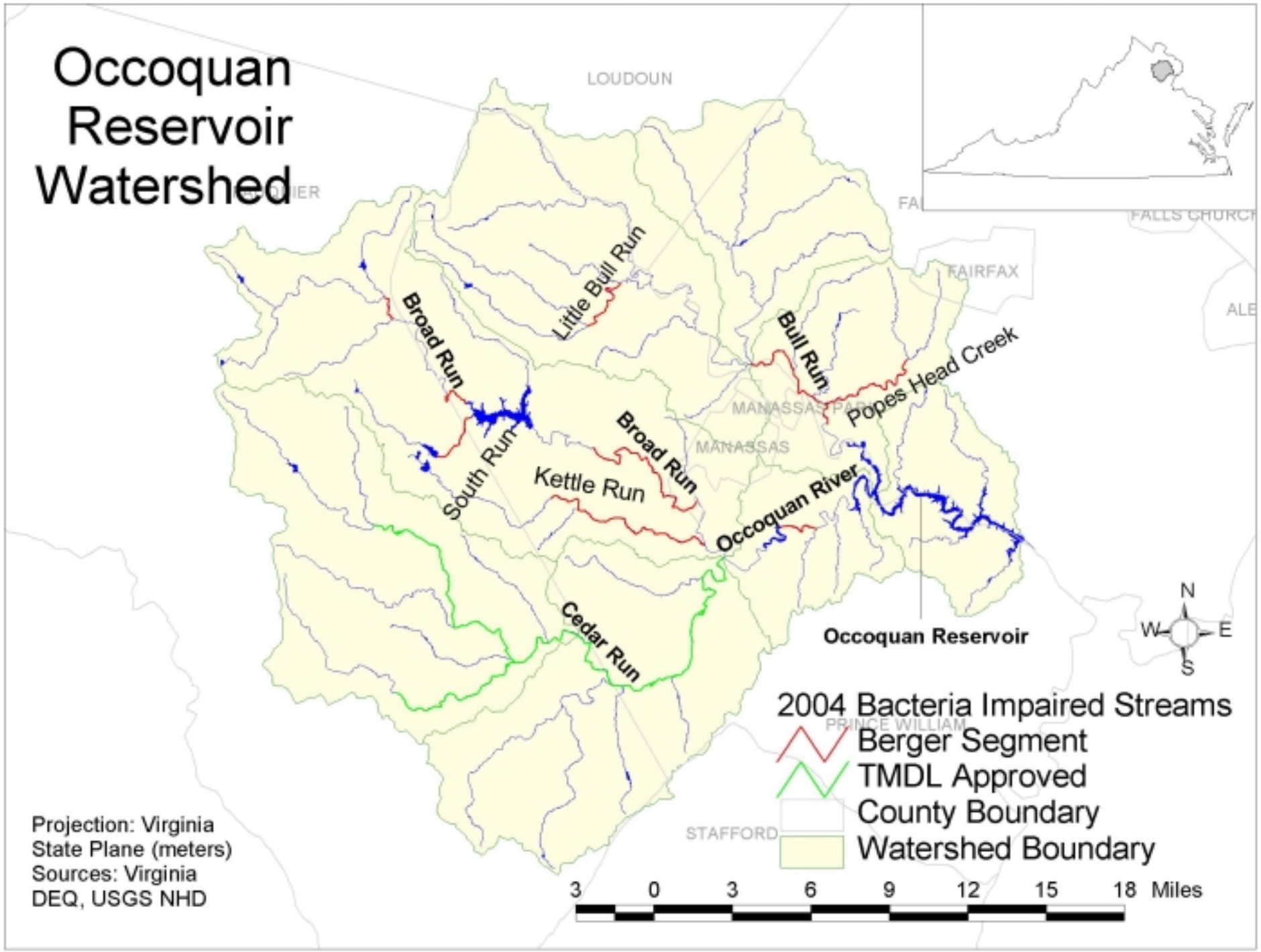
- To present and review the steps and the data used in the development of bacteria and benthic TMDLs for listed segments in the Occoquan River Basin.

Bacteria TMDL Development

Occoquan River Basin Listed Segments

Bacteria

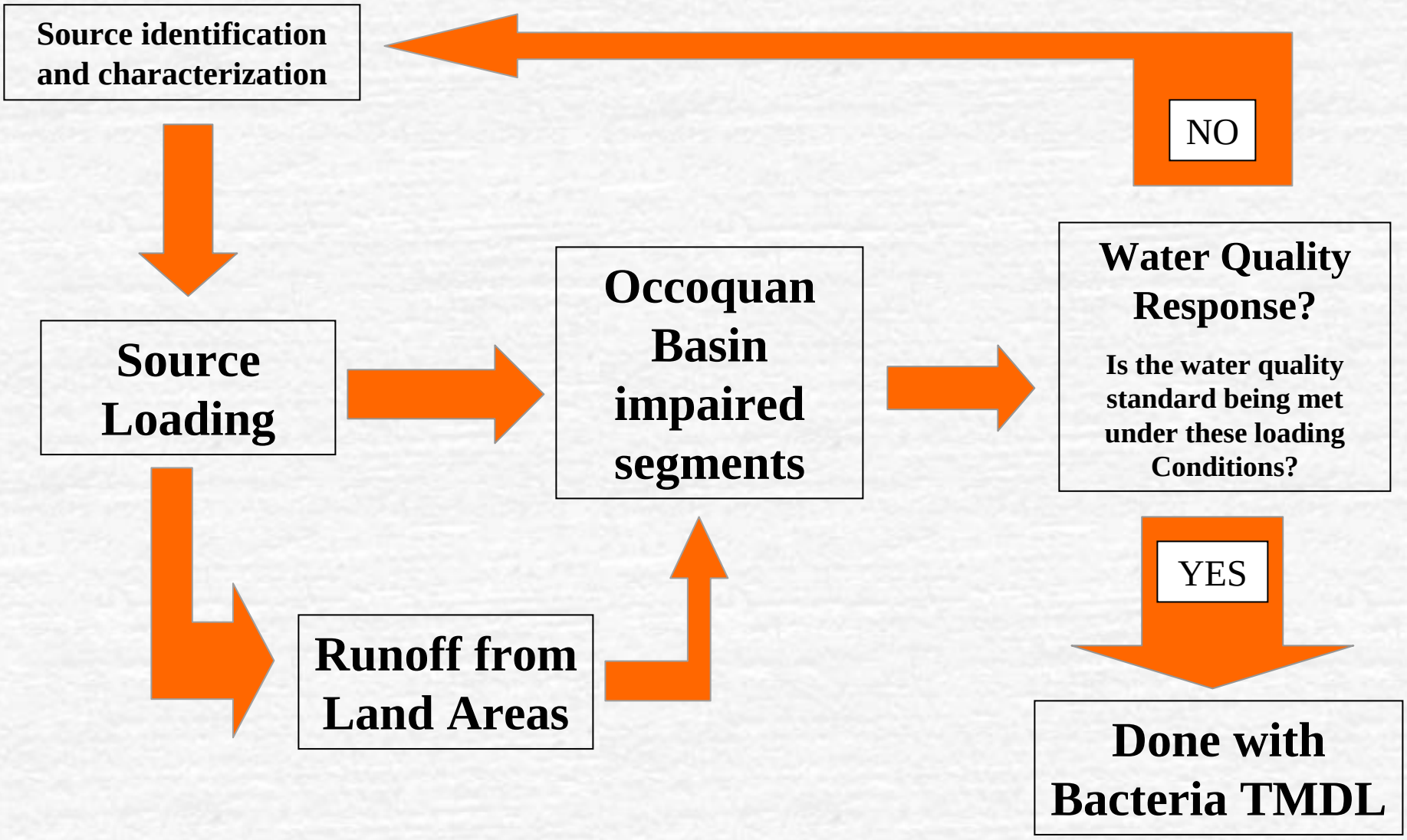
WATERBODY ID	Stream	County/City	Length (mi.)	Impairment
VAN-A19R	Broad Run	Prince William	1.51	Bacteria
VAN-A19R	Broad Run	Prince William	7.26	Bacteria
VAN-A19R	Broad Run	Prince William	1.06	Bacteria
VAN-A19R	South Run	Fauquier, Prince William	2.34	Bacteria
VAN-A19R	Kettle Run	Prince William	7.59	Bacteria
VAN-A20R	Occoquan River	Prince William	1.61	Bacteria
VAN-A21R	Little Bull Run	Prince William	3.03	Bacteria
VAN-A23R	Bull Run	Prince William, Fairfax	5.75	Bacteria
VAN-A23R	Popes Head Creek	Fairfax	4.92	Bacteria


Occoquan Reservoir Watershed
LOUDOUN
FAIRFAX
MANASSAS
MANASSAS PARK
PRINCE WILLIAM
STAFFORD
Little Bull Run
Broad Run
Bull Run
Popes Head Creek
South Run
Kettle Run
Broad Run
Occoquan River
Cedar Run
Occoquan Reservoir
N
W
E
S
2004 Bacteria Impaired Streams
Berger Segment
TMDL Approved
County Boundary
Watershed Boundary
3 0 3 6 9 12 15 18 Miles
Projection: Virginia State Plane (meters)
Sources: Virginia DEQ, USGS NHD

Bacteria Water Quality Standards

- Bacteria Impairment: the Primary Contact Recreation designated use is not met due to exceedances of the water quality criterion for bacteria
- A segment is listed as impaired if more than 10% of samples exceed the criteria
- As of January 15, 2003, E. coli is used as the indicator species instead of Fecal Coliform
- Virginia and EPA have agreed on a translator for TMDL model development
  - The Section 303(d) listing is for fecal coliform, the TMDLs will be developed for E. Coli

Bacteria TMDL Development



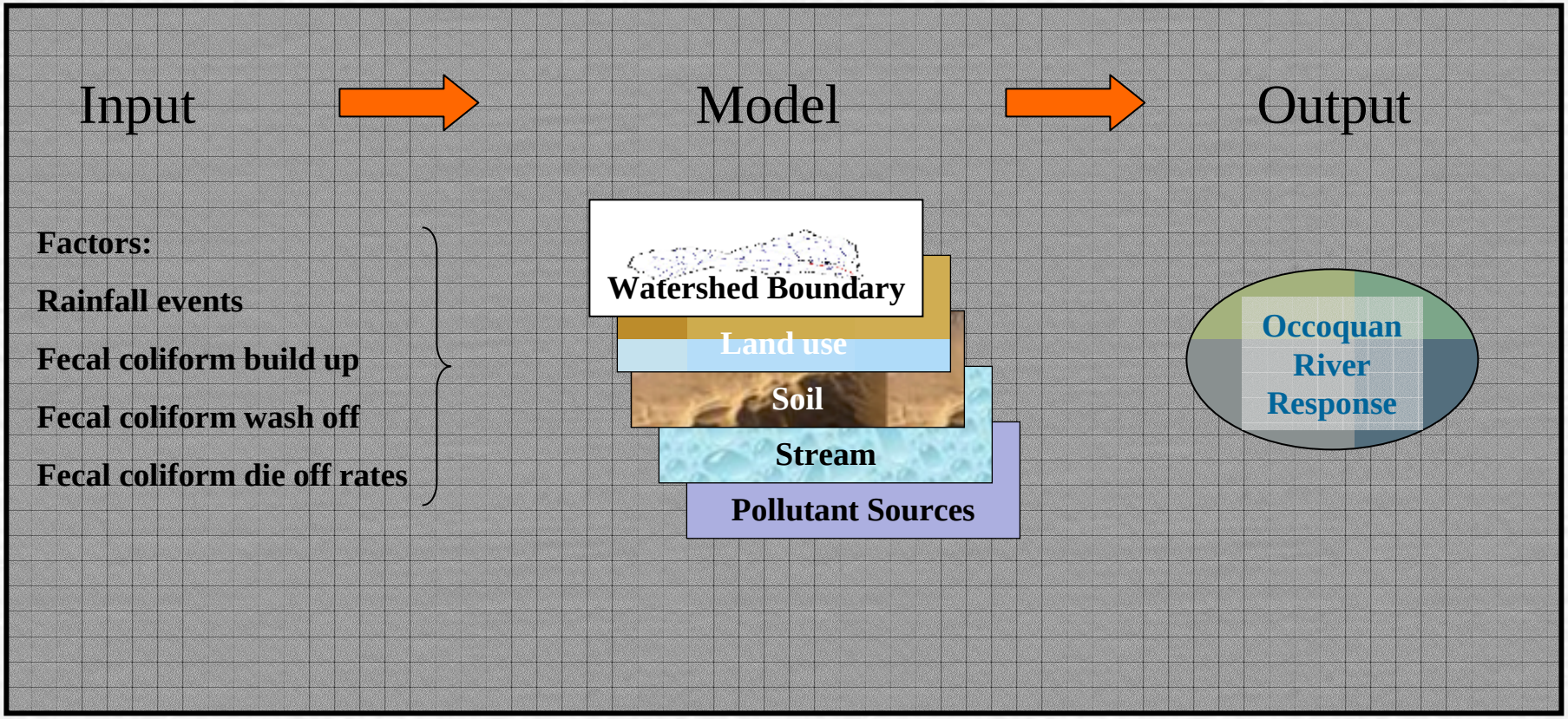
Water Quality Model

Hydrologic Simulation Program Fortran (HSPF)

- Hydrologic Model
- Watershed Model
- State of the art Modeling System
- EPA approved approach

HSPF Model

Linking Sources to Water Quality

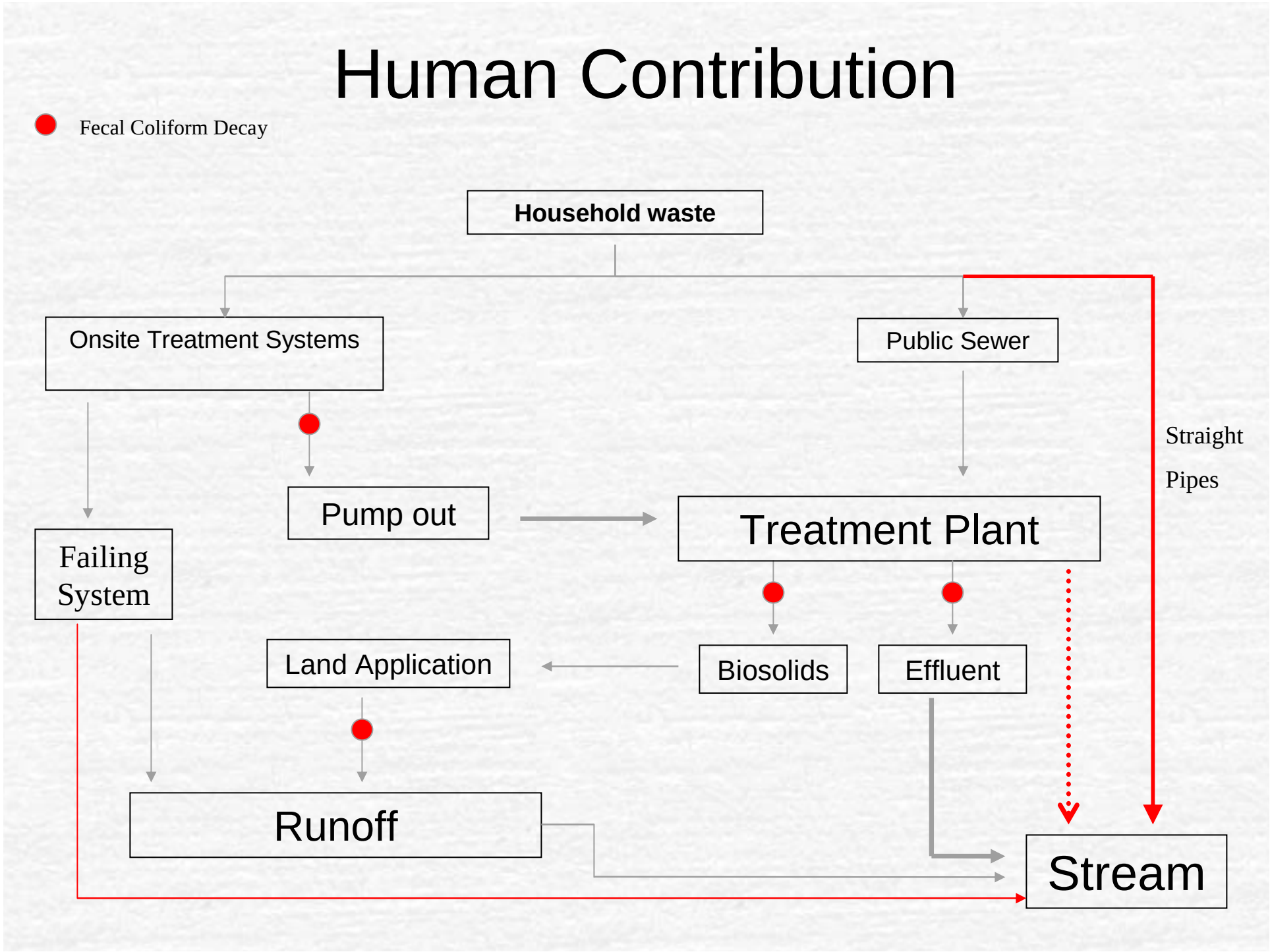


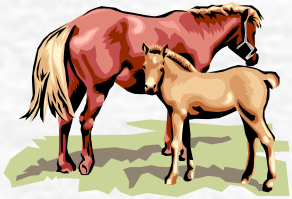
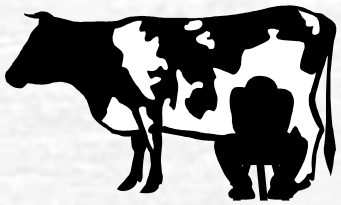
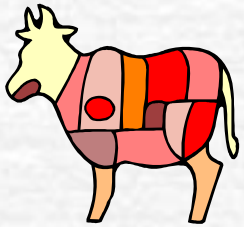
Bacteria Sources Assessment

Addresses the following issues related to bacteria production:

- Fecal Coliform loading from Human Sources
  - Straight pipes
  - Septic systems
  - Biosolids
- Fecal Coliform loading from Livestock
  - Livestock inventory
  - Livestock grazing and stream access
  - Confined animal facilities
  - Manure management
- Fecal coliform loading from Wildlife
  - Wildlife Inventories
- Fecal Coliform loading from Pets
  - Pet Inventories
- Best management practices (BMPs)

Human Contribution



Livestock

Pasture

Confinement

Manure Storage

Manure Spreading

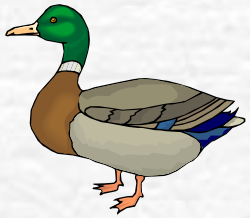
Pasture

Cropland

Runoff

Stream

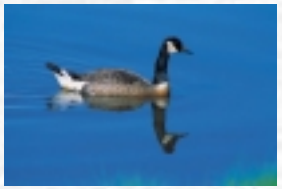
Fecal Coliform Decay



Wildlife

Pasture | Cropland | Forest | Built-up area

Runoff



Stream

Fecal Coliform Decay

Pets: Dogs & Cats

Pasture | Cropland | Forest | Built-up area

Runoff

Stream

Fecal Coliform Decay

Source Loading Estimates

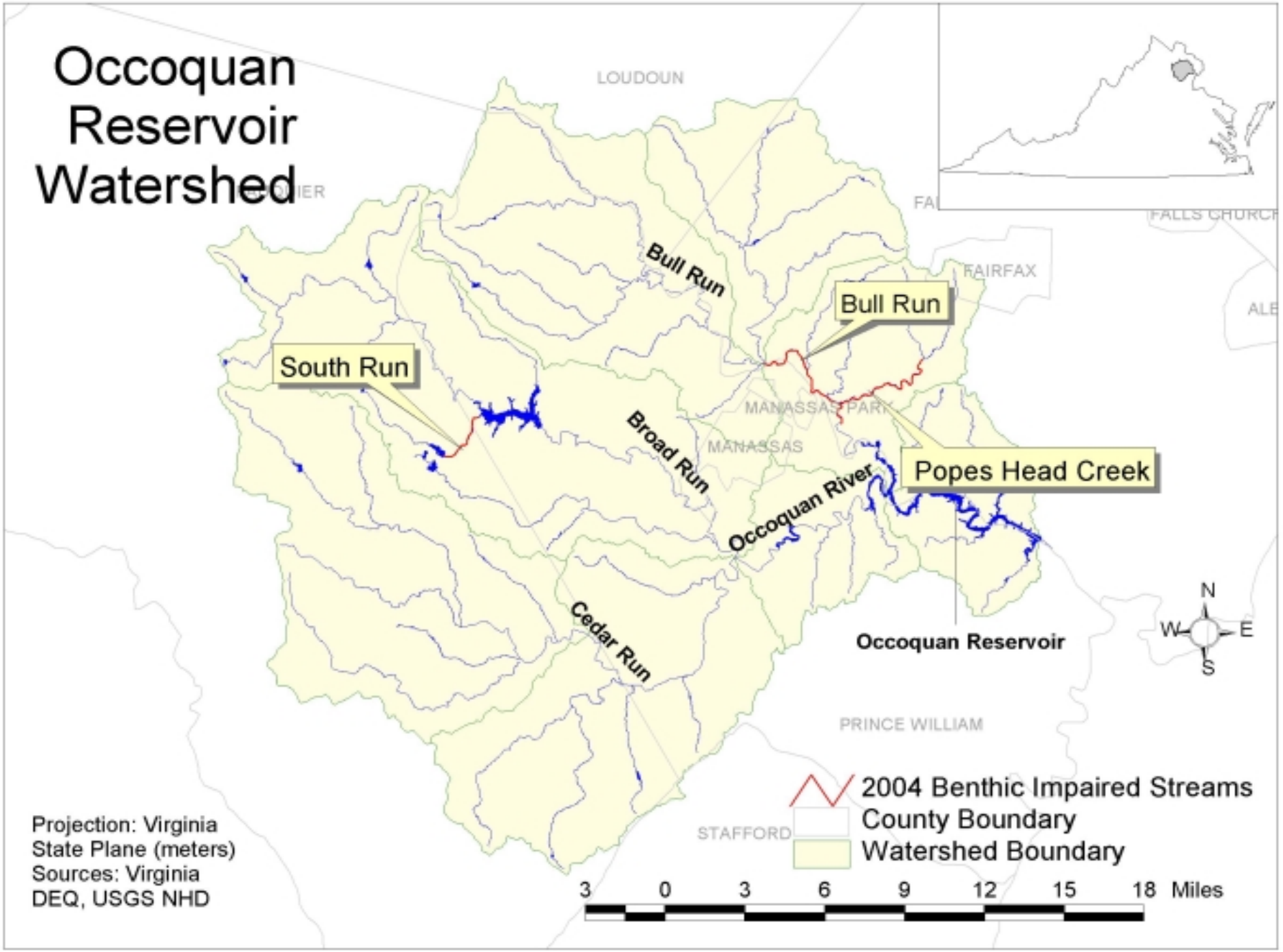
- Determine the daily fecal coliform production by source
- Estimate the size/number of each source
- Determine whether the source is
  - Direct Source
  - Indirect Source
- Calculate the load to each land use based on a monthly schedule and for each source
- The sum of all the individual sources is the total load
- Source loading estimates used in HSPF model to simulate in-stream bacteria concentrations

Benthic TMDL Development

Occoquan River Basin Listed Segments

Benthic

WATERBODY ID	Stream	County/City	Length (mi.)	Impairment
VAN-A19R	South Run	Fauquier, Prince William	2.34	Benthic
VAN-A23R	Bull Run	Prince William, Fairfax	15.64	Benthic
VAN-A23R	Popes Head Creek	Fairfax	4.92	Benthic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LOUDOUN
FAIRFAX
FALLS CHURCH
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Bull Run
Bull Run
South Run
Broad Run
Occoquan River
Popes Head Creek
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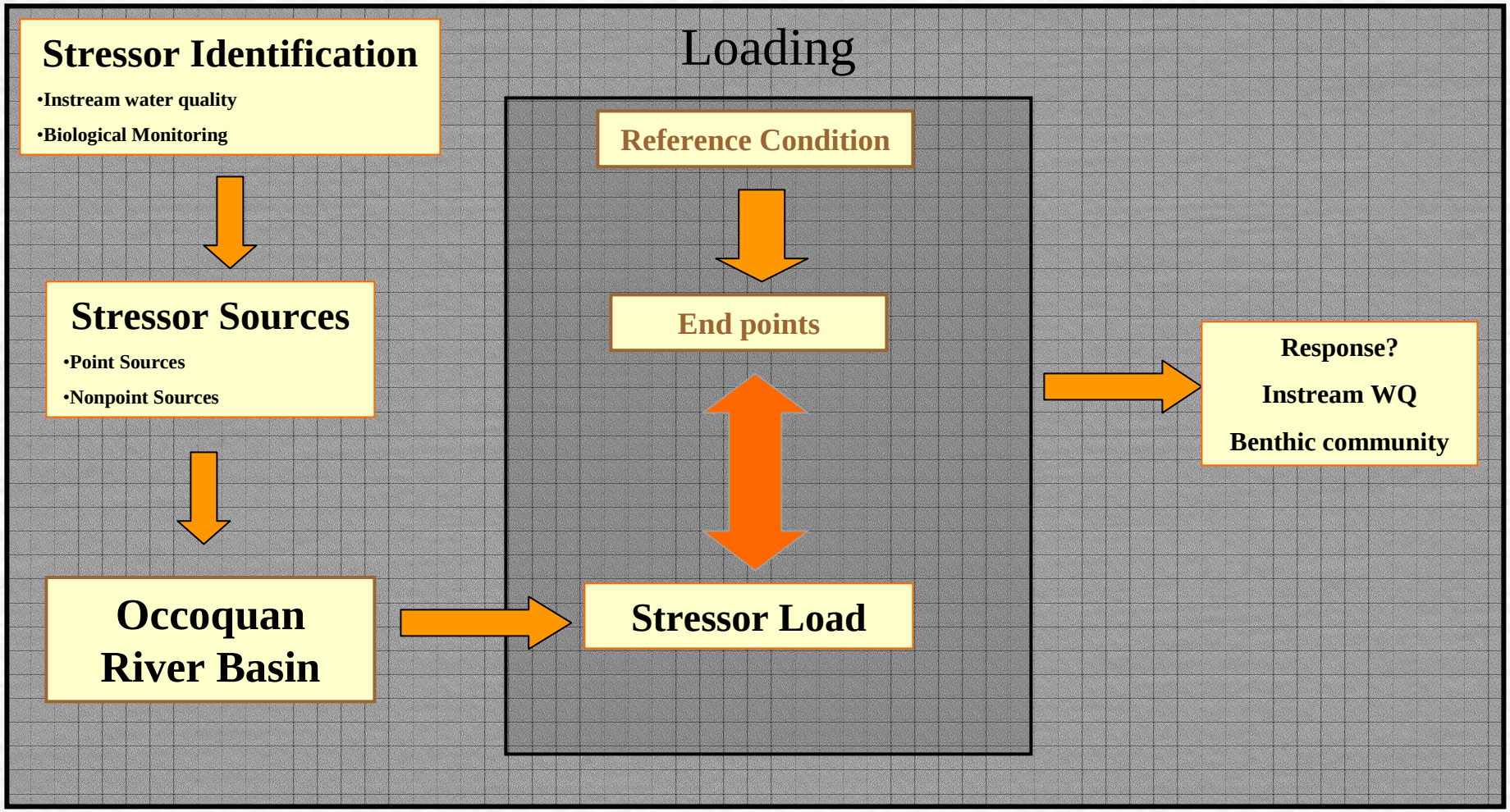
S
2004 Benthic Impaired Streams
County Boundary
Watershed Boundary
3 0 3 6 9 12 15 18 Miles
Projection: Virginia State Plane (meters)
Sources: Virginia DEQ, USGS NHD

TMDL Process for Benthic Impairment



Benthic Stressor Identification

- What pollutant(s) is causing the impairment of the benthic community?
- Common stressors include:
  - Dissolved Oxygen
  - Nutrients
  - pH
  - Temperature
  - Sediment
  - Toxics

Data Used in Stressor Identification

1. Water Quality Data
    a) Instream water quality data

2. Biological Assessment Data
    a) Assessments performed since 1994
    b) Habitat assessments

3. Toxicity Testing
    a) Acute toxicity testing
    b) Chronic toxicity testing

4. Discharge Monitoring Reports (DMR)

5. Field notes and observations

Benthic TMDL Development

After primary stressor impacting biological community is identified:

- Biological reference condition established
  - Reference watershed approach
  - Endpoint identification
- Primary stressor pollutant modeled
- TMDL developed by determining load reductions need to achieve reference conditions

Data Needs

Data and Information Needs:

- Watershed physiographic data
- Hydrographic data
- Weather data
- Point sources and direct discharge data and information
- Environmental monitoring data
- Stream flow data
- Bacteria sources assessment data
- Benthic stressor identification data

Watershed physiographic data:

Type of Information	Data Source	Obtained	Processed/ Analyzed	Notes
Stream network	*Reach File Version 3 (US EPA BASINS)* *National Hydrography Data (USGS)*	Yes	Yes	
Land Use/ Land Cover data	***Northern Virginia Regional Commission*** *Land Cover Data 2000* *National Land Cover Data (NLCD) 1992*	Yes	Yes	Gaps in NVRC 2000 land cover data have been filled in with NLCD data to create a hybrid dataset
Soils	*USDA State Soil Geographic Database (STATSGO)*	Yes	Yes	
Digital Elevation Model (DEM)	*BASINS*	Yes	Yes	30-meter DEM resolution

Environmental & Monitoring data:

Type of Information	Data Source	Obtained	Processed/ Analyzed	Notes
Monitoring data and station locations	*Virginia Department of Environmental Quality* ***Occoquan Watershed Monitoring Laboratory*** *Local agencies and universities* *Citizen monitoring groups*	In Progress	In Progress	Includes ambient water quality data, biological data, dissolved and sediment metals/toxics data, fish tissue data, and steam toxicity testing
Meteorological data	*National Climatic Data Center (NCDC)*	Yes	In Progress	Data include: hourly rainfall, temperature, wind speed, dew point temperature, humidity, cloud cover, solar radiation
Stream flow data	*U.S. Geological Survey* ***Occoquan Watershed Monitoring Laboratory***	In Progress	In Progress	Continuous daily stream flow record required
Permitted facility locations and discharge monitoring reports (DMR)	*Virginia Department of Environmental Quality*	In Progress	In Progress	DEQ currently compiling information
Stream geometry data	*BASINS* *U.S. Geological Survey* *Field surveys*	In Progress	In Progress	Information may be needed as model input

Bacteria Sources Assessment data:

Type of Information	Data Source	Obtained	Processed/ Analyzed
Population/ Household/ Septic System Estimates	*U.S. Census Bureau*	Yes	In Progress
Livestock estimates/ agricultural practices	*USDA National Agricultural Statistics Service* *Soil and Water Conservation Districts* *Virginia Department of Health*	In Progress	In Progress
Wildlife estimates	*Virginia Department of Game and Inland Fisheries*	Yes	In Progress
Pet Estimates	*U.S. Census Bureau* *National pet estimates per household*	Yes	In Progress
Combined-sewer and stormwater outfall locations	*Virginia Department of Environmental Quality* *Local agencies*	No	No
Active and historical industrial site locations	*Virginia Department of Environmental Quality* *Local agencies and stakeholders*	No	No

Benthic Stressor Identification data:

Type of Information	Data Source	Obtained	Processed/ Analyzed
Macroinvertebrate monitoring data	*Virginia Department of Environmental Quality* *Local agencies* *Universities* *Citizen monitoring groups*	In Progress	In Progress
RBPII & Stream condition index scores	*Virginia Department of Environmental Quality*	Yes	In Progress
Water Quality Monitoring Data	*Virginia Department of Environmental Quality* *Occoquan Watershed Monitoring Laboratory* *Local agencies and universities* *Citizen monitoring groups*	In Progress	In Progress
Acute/Chronic Toxicity Study	*Virginia Department of Environmental Quality* *U.S. Environmental Protection Agency*	In Progress	In Progress
Facility Discharge Monitoring Reports	*Virginia Department of Environmental Quality* *Local agencies*	In Progress	In Progress

Timeline and Deliverables

- Completion date for TMDLs: Spring 2006
- Final TMDL Reports
- TAC and Public Meetings #3
- Draft TMDL Reports
- TAC and Public Meetings #2
- Stressor Identification Analysis Reports
- Sources Assessment and Characterization Reports
- TAC and Public Meetings #1

Next Steps

- Collect available data
- Analyze data to investigate the bacteria and benthic impairments in the watershed
- Conduct biological stressor identification and prepare reports
- Develop bacteria source loading estimates
- Develop the modeling input parameters

Local TMDL Contacts

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